

Cancer Patterns in the Oil Shale Area of the Estonian S.S.R.

by Maret Purde* and Mati Rahu*

Age-adjusted incidence rates of stomach, lung, and skin cancer among urban (1967-1972) and rural (1963-1972) population of four administrative districts in the Estonian S.S.R. have been presented. In the Kohtla-Järve district (oil shale area) there was an excess of stomach and lung cancer. High rates of stomach cancer in towns and boroughs of oil shale area may be explained by migration. A great proportion of migrants comes from regions, where incidence rates are 1.6-2.5 times higher than among Estonians. Elevated levels of stomach cancer incidence in rural areas of Kohtla-Järve district remained unexplainable. In a retrospective cohort study of 2069 workers who had been exposed to oil shale products from 10 to 20 years an excess of skin cancer in females was found.

Areas of the geographic concentration of industry represent special interest for epidemiologists, examining correlations between environmental hazards and cancer patterns. The highly industrialized northeastern part of Estonia is a natural object for study deserving our attention. It is a territorial industrial production complex that expanded due to oil shale development in the last 50 years (1). Taking into consideration the well known relationship between general environmental pollution and the level of industrial development, we studied the geographical distribution of the selected sites of cancer among urban and rural populations in different administrative districts in Estonia.

Table 1 presents age-dependent incidence data for the population in four districts and in all of Estonia. Regional differences in cancer incidence in both sexes are considerable. Stomach cancer (ICD 151) occurs most frequently in urban and rural areas of the Kohtla-Järve district (oil shale basin). Similarly the difference of lung cancer (ICD 162-163) rates between this area and all of Estonia is statistically significant ($p < 0.05$) in rural males. Increased rates of skin cancer (ICD 173) were found in the Võru district.

Although higher stomach and lung cancer rates are recorded in the industrial northeast, the observed spatial correlation must be interpreted with caution. Thus, geographical differences of stomach

cancer incidence in Estonia can largely be explained by migration. For example, 73% of stomach cancer patients in Kohtla-Järve urban areas have migrated from other Union Republics; a high number of these migrants are from areas where age-dependent frequency of stomach cancer is 1.6-2.5 times higher than among Estonians. As published elsewhere (2) in Estonia in 1968-1971 stomach cancer incidence rates in Russians were 1.7-2.0 times higher than in Estonians. In addition, in towns and boroughs of the Kohtla-Järve district 70% of new stomach cancer patients have been living in this district for less than 20 years.

The above figures indicate convincingly that migration is a significant variable in the studies of geographical correlations between incidence cancer patterns in the general population and industrial phenomena.

However, at the present stage of our research we cannot give a satisfactory explanation for the high rates of stomach cancer in rural population in the oil shale district. Only a negligible part of this excess number may be explained by migration. The concentrations of benzo(a)pyrene in samples of soil, drinking water and potatoes in rural areas of the Kohtla-Järve district did not differ significantly from those in the control district (3).

An analytical study was undertaken to determine whether cancer is associated with occupational variables in the oil shale industry.

For this study, 2069 oil shale workers were retrospectively examined. They had been exposed to

* Institute of Experimental and Clinical Medicine, 42 Hiiumäe St., Tallinn 200015, Est. S.S.R.

Table 1. Age-standardized incidence rates per 100,000 of stomach, lung, and skin cancer among urban (1967-1972) and rural (1963-1972) population of selected administrative districts in the Estonian S.S.R.^a

Administrative district (socio-economic type)	Population	Incidence/100,000 ^b					
		Stomach		Lung		Skin	
		Male	Female	Male	Female	Male	Female
Kohtla-Järve (young industrial)	Urban	103(90-119)	58(51-66)	75(63-89)	11(8-15)	22(16-30)	26(21-32)
	Rural	101(85-120)	53(44-64)	90(75-107)	5(2-8)	21(14-30)	20(15-27)
Kingsisepa (extensive agrarian-fishing)	Urban	56(27-102)	30(15-53)	73(39-125)	8(2-25)	0(0-9)	19(7-38)
	Rural	65(52-81)	40(33-48)	44(34-58)	3(1-6)	18(12-27)	14(10-19)
Viljandi (highly-developed agrarian)	Urban	60(43-82)	34(25-45)	70(52-93)	5(2-10)	27(16-42)	27(19-37)
	Rural	50(41-61)	25(20-31)	71(60-84)	3(2-6)	21(15-28)	22(18-28)
Võru (agrarian)	Urban	39(20-68)	32(19-50)	57(34-90)	5(1-15)	39(20-68)	35(22-54)
	Rural	78(66-93)	46(38-54)	71(59-85)	8(5-12)	26(19-34)	29(23-36)
Estonian S.S.R.	Urban	81(77-86)	41(39-44)	84(80-89)	10(9-11)	30(27-32)	26(24-27)
	Rural	74(71-78)	39(37-41)	69(65-72)	7(6-8)	23(21-25)	20(19-22)

^a The rates were adjusted by the indirect method with the Estonian S.S.R. corresponding figures for 1968-1971 as the standards. The adjustment was performed using age groupings 0-4, 5-9, . . . , 80-84 and 85+.

^b Poisson distribution 95% confidence limits for the standardized incidence rates are shown in parentheses.

oil shale products for 10 to 20 years. The follow-up period was 20 years (1956-1975). The workers' contacts with carcinogens were investigated according to their occupations with regard to benzo(a)pyrene content at the work place, including the air. We compared cancer incidence rates in oil shale processing workers and the entire population of Estonia. Sex-age specific cancer incidence rates in 1968-1970 in Estonia have been taken as a standard.

As the result of this study, 89 cancer cases (stomach in 23.6%, skin in 15.7%, lung in 13.5%, uterus in 13.5%) were found. The preliminary results show that stomach and lung cancer incidence rates do not differ significantly in oil shale workers and the general population of Estonia. The excess of skin cancer cases occurred only among women who had worked from 10 to 20 years in the above mentioned industry. Their age was lower than the average age at the onset of skin cancer cases in

Estonia. It seems most likely, that the high ratio for skin cancer reflects an occupational hazard in women working in the oil shale processing industry. Thus, one must consider the possibility that the products of oil shale processing are responsible for at least some skin cancer cases.

As oil shale production is a relatively new branch of industry, it will take several decades before a final conclusion can be made on the carcinogenic action of oil shale products in man.

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